

THE CREMASTOGASTER ANT.

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(With a plate.)

Common Ants of Baghdad—Characters of Cremastogaster—Its nest—Food supply—Treatment of dead and wounded—Erection of abdomen—Pastoral activities—Architecture of byres—Care of cattle—Instinct of communication—Olfactory sense—Judgment of workers—A beetle mimic.

The observer at the fringe of the Baghdad oasis cannot fail to find his notice soon directed to the varied kinds of ants. The most prominent are those which inhabit the soil. There is *Messor*, the harvester, a maker of roads. It loves to establish itself near some cultivated field where it fashions a smooth and conspicuous thoroughfare between the harvesting area and the granaries in the nest. This thoroughfare is the highway for the movements of the ants along which they incessantly pass to and fro. We see them first exploring the field of harvest, then converging with their burdens to the extremity of the path, then advancing steadfastly along the road until they disappear through the entrance of the nest. None can fail to notice these industrious streams, so constant in purpose, so determined in effort, so free from all obstruction or confusion, so striking an example of well organised labour in which each is fulfilling its share in the toil.

In the vicinity we are sure to find another kind of ant. This is the large and formidable *Myrmecocystus*, which digs deep galleries into the bare sand, selecting if available some sloping bank. The workers are very different from the peaceful harvesters, their character being that of the rapacious hunter, active, swift, individually powerful, and capable of overwhelming all kinds of insects which they drag as provender into the nest. In their movements they are not confined to special roads, but they scour the sand in all directions, each worker securing its individual capture by virtue of its own activity and strength. At the nest we will observe the more remarkable of their performances, such as their skill in evacuating large piles of sand, their manner of ejecting dead insect shells, their wonderful method of conducting a migration by which one worker seizes hold of a comrade and transports it bodily to the new home.

The habits of these species I have elsewhere discussed*. For new material we must turn to more secluded haunts. In the shady gardens we will meet with another kind, one smaller and less conspicuous than the inhabitants of the sand, a species that keeps almost exclusively to the vegetation and known to science as *Cremastogaster auberti* (var. *sorokini*).

It is not likely to attract immediate attention, being peaceful in its habits, methodical in its behaviour, and neither like *Messor* going in search of seeds, nor like *Myrmecocystus* pursuing prey. It indulges rather in the tranquil occupation of a quiet pastoral life. Its length does not exceed one-seventh of an inch, though it is of moderately sturdy build. In front is the somewhat square-shaped head with minute black eyes and club-like antennæ. Behind this comes the thorax raised into an arch and furnished with two projecting spines. A slender nodulated waist connects this with the abdomen, of which the noticeable feature is the triangular shape with the base in front where it joins the waist and terminating in a sharp apex behind. There is some variety in its pattern of colour, the head and thorax being a reddish brown, the abdomen a glossy black. Its body is altogether naked save for a trace of fine silky hairs. (See *Plate*).

The nest is constructed in the hollow of a tree, often in some crumbling cavity of the trunk, or, if near the ground, in a decomposing root. Occasionally they may occupy a crevice in the soil or the tubular cavity of a dead hollow stick. In

* In "A Naturalist in Himalaya."

India I have seen an allied kind choose the thorns of an acacia and empty the pith from a stalk of elephant grass in order to establish a suitable nest. The broken end of a branch is a favoured situation. There the exposed wood soon passes to decay. It becomes soft, is easily tunnelled, and falls to the attack of boring beetles which perforate the decomposing stump. The ants take advantage of the beetles' excavations and appropriate the tunnels for their own use.

The entrance to the nest is but a mere slit, quite unlikely to attract attention and with little or no excavated debris outside. The interior is hollowed into smooth chambers which communicate with one another by narrow galleries and contain the usual larvæ and eggs. Males and females also will be found in the passages, and, of course, a number of the worker caste. From the gateway proceeds a steady line of ants, some ascending, others descending, up and down the trunk of the tree. As excavators they show no conspicuous talent, never heaping up piles of ejected debris after the manner of the vigorous inhabitants of the soil.

They gain most of their sustenance through pastoral activities, attending on different kinds of bugs which supply them with a limpid juice. Much also is obtained by just biting at the foliage or at the young unopened buds. Certain leaves have little glands which emit fluid, and this excretion is acceptable to the ants. They will carry off small particles of animal matter. The minutest insects too will be taken to the nest, some of which are probably captured alive. But, like many ants, it is fluid that they really seek, and will accept either animal or vegetable juice. They will suck up the liquid from a disembowelled insect, or encircle a drop of syrup in peaceful contentment, all crowding round the delicious nectar in a greedy motionless ring.

These ants are partial to many kinds of trees, being commonly found on the poplar and mulberry, less often on the pomegranate and palm. The cultivated fig is a particular favourite, since its leaves are often crowded with the liquid-giving cattle and its timber honeycombed by insect pests. The ants are thus supplied with their two requirements, a profusion of food distributed through the foliage and nesting places dug into the branches and trunk. A species of *Capparis* also attracts them, its beautiful white flowers and purple tipped stamens being one of the chief adornments of this soil. They are constantly licking at its stems and leaves, though they come to it mainly for the buds and fruit. Indeed every part of this thorny shrub appears capable of supplying something to the ants. At the buds they chew the soft external coat and reach the vegetable tissue direct. The fruit supplies them with a richer provender. It opens widely so as to expose the seeds which are sunk in a sweet gelatinous fluid coloured a bright red. Round this viscid material the ants collect, often a large number at one open fruit all eagerly sipping at the juice.

Their peaceful character is evident in their treatment of the dead and wounded. Most ants, when they meet with an injured comrade, are thrown into the greatest flurry and excitement, often dashing at it with wide-open jaws, attacking it with the same intensity and vigour as if it were an enemy rather than a friend. They often treat it after the manner of cannibals. The *Myrmecocystus*, for example, after first lynching it, drags it for provender into the gate. The *Ecophylla* employs it to a similar purpose, the workers coming round it in a murderous ring and literally stretching it to death. They treat their dead with the same disrespect and bring them to the formicary for use as food. It is otherwise in the case of the peaceful *Cremastogaster*. I place some dead and injured comrades near the nest. There is no display of violent hostility, no indication of any serious alarm. After a little while the workers take up their dead, carry them quietly to some distance from the formicary where they lodge them in a retired nook amidst the leaves. Thus these ants make some decent disposal of their dead which to other kinds are of value solely as food.

It is a well-known habit of the *Cremaastogaster* ants that they erect their abdomens at right angles to their bodies when they happen to be alarmed. In this little species the behaviour was not conspicuous. At times, when closely pressed, it would certainly do so, but never in that persistent angry manner which we observe in some of the larger kinds. In a previous book I have made mention of this special habit, and suggested that its purpose was to serve as a balance during the ascent and descent of a tree. But I now feel sure that this explanation is incorrect. The behaviour is part of a defensive plan. At the tip of the abdomen is a fragile sting, so minute as to be invisible without the help of a lens and suitable only for delicate work. It cannot, for example, pierce the skin of the hand, but, in other parts, such as the neck, where the integument is thin, the spear can give a sharp prick. A reservoir of poison communicates with the weapon, and the fluid may be seen exuding from its tip in the form of a watery drop. When the *Cremaastogaster* meets with an insect enemy, as I have observed in the larger kinds on Indian trees, it immediately erects the triangular abdomen and emits the venomous juice. The attacker, which may for instance be a *Pre-nolepis* ant, knows clearly the meaning of this abdominal erection. It hurriedly withdraws from the danger signal and thus escapes any injurious effect. The elevation of the abdomen is a warning act, part of the defensive scheme of operations associated with the possession of poison and sting.

Such strategy can be of use against only the smallest enemies. It could scarcely serve as a protection from birds. But birds, as a rule, are not partial to ants. They probably dislike the formic acid taste. The woodpecker, however, is a formidable enemy. Though in Mesopotamia it is extremely rare, yet in wooded districts no other bird feeds so habitually on *Cremaastogaster* ants. Moreover, the ants seem aware of their enemy, at least the larger species on Indian trees instinctively adopt a method of escape. With the edge of my killing-bottle I have sometimes struck the tree immediately below a *Cremaastogaster* ant. It was a sharp and sudden tap such as a woodpecker makes on the bark when hammering with its chisel beak. And often when I did so the ant stood still, fixed itself motionless close against the bark. No doubt it imagined that its enemy had arrived, and instinctively felt that the immobile attitude supplied the best chance of its being passed unseen.

These ants, as I have said, are of a pastoral disposition, depending in the main on other insects which, like cattle, supply them with a valuable juice. In this connection the aphids are of great importance. The workers go in search of them all over the tree. They find numbers on both the stems and leaves of the poplar, but the place of selection seems to be the stalk close to its junction with the leaf. In their search they employ the plan of circumnavigation, especially when investigating the smaller leaves. This is a methodical system of examination, the ant running round the edge of one leaf before passing on to explore the next. It is a good example of their orderly activities as a result of which the whole mass of the foliage is surveyed.

When they find a group of aphids they pay it close attention. The workers collect around it in a cluster, not displaying any emotion or excitement, but just quietly attending the herd. Their antennæ may be seen in continuous motion, since these organs are made to stroke the bodies of the aphids as if to induce them to render forth their juice. At intervals we will observe the emission to take place. Each little aphid hoists up its abdomen, squeezes out from the tip a drop of limpid fluid which the ant that is stroking it immediately devours. All over the tree we may detect these little parties, each a quiet pastoral association in which the ants are the herdsmen and the aphids the herds.

This poplar aphid is very minute, to the naked eye little more than a speck. The members of the herd are usually wingless, being for the most part young and immature forms. At this stage they are somewhat fusiform in shape. The head end is blunt, supplied with eyes and antennæ, while the hind extremity is

distinctly pointed and prolonged into a kind of tail. Its structure is so delicate as to be almost transparent, and its general colour is a pale green with a tinge of brown upon the head. At the tail extremity is the tiny pore through which the excretion is emitted to the ants. Here and there in the clusters we meet with an adult, a little insect of graceful and delicate structure with a dark body and white-lacy wings. It receives the same attention from the herdsmen as is given to the undeveloped forms. Its association with the herd is only temporary. Hitherto it has been a mere reservoir of liquid, a stationary apparatus for the withdrawal of sap. But now it has developed gauzy wings; its reproductive instinct claims attention, and it flies off to find another resting place where it becomes the parent of a new group.

The strength of a commune of *Cremastogaster* ants will depend in the main on the numbers of these herds. A tree covered with cattle will maintain a multitude, while one that bears a few scattered groups can support only an impoverished nest. These aphids withdraw a great quantity of sap and must often do considerable injury to the trees. This is particularly the case with the apricot. They infest the tree in immense numbers, so much so that the fluid falls from them like rain and coats the verdure in a sticky juice. Other insects then come to reap the harvest, especially the hornets and certain species of wasps which eagerly drink the sweet honey-dew.

The special preference which *Cremastogaster* gives to the fig is due, like the poplar, to the cattle on its leaves. Almost every fig tree in these shady gardens maintains its quiet procession of ants. The herd is, however, different from that on the poplar. It is composed of a cluster of scale insects or coccids, another of the heterogeneous group of bugs. This little insect is oval in shape, soft and delicate, looking almost structureless except for the fact that its margin is sinuous and its body divided into rings. It is hidden from view in a kind of fluffy material, the product of its cast-off skins. These accumulate around it so as to form a white coat which makes it look like a flake of snow.

The coccids usually occupy the base of a leaf. They also align themselves along the midrib, wrap themselves around the green stalk or assemble on the stem of the fruit. Often they collect in a dense cluster with their edges overlapping like a heap of coins and buried in their discarded skins. Both old and young are represented in the herd. The foliage around them often glistens as if with varnish. This is due to the viscid secretion of the coccids having escaped and then dried into an inspissated layer. The ants attend these cattle in the same way as they do the aphids, standing around them like patient herdsmen and titillating persistently with their antennary threads.

These ants, like certain other kinds that tend on cattle, construct special habitations for the shelter of the herd. But the byres of the *Cremastogaster* are neither very common nor are they built in that wonderfully elaborate manner such as is displayed by the *Polyrhachis* ants. I found one of their sheds in the fork of a pomegranate tree. It was a triangular shaped edifice wedged into the cleft and somewhat less than an inch in length. Its structure was composed of delicate material, an assortment of fine particles of vegetable tissue built into a compact wall. Inhabiting this tabernacle was a pair of coccids, a meagre collection for so elaborate a shed. Yet even so few were of great value to the ants; otherwise they would never have expended the labour of enclosing them in a firm wall. The reason is, of course, that their value is continuous. Day and night they give forth their droplets of fluid which is probably sufficient for a number of the ants.

I found another exquisite type of chamber fashioned exclusively from downy seeds. There is a profusion of such material at the end of the summer, the trees being in places so laden with fluff as to appear under a fleece of snow. Some is shed from the seeds of the poplar; more from the smaller plants. The byre

composed of it was on the trunk of a poplar tree. It was oval in shape, about the size of a walnut, smooth in the interior, but on the outside rough so as to look like a fluffy ball. Though delicate in structure, it was closely interwoven, the downy plumes being so knit together as to form an unbroken wall. At one extremity was a small gateway, the only opening into the cavity of the cell. It was merely a slit of the narrowest dimensions and just sufficient to permit the entrance of the ants. Some stems of the poplar passed through the interior round which the aphids were closely packed like cattle stabled within a shed. The whole habitation was delightfully snug, as soft and cosy as if composed of wool, and a most efficient protection for both the cattle and the ants. (See plate).

A neat pattern of byre is occasionally met with fashioned out of a poplar leaf. The leaf has been folded longitudinally so that the lateral edges come together and the midrib marks the line of the fold. The edges are observed to be connected with silk which results in the formation of a leafy tube. The open ends of the tube must then be secured, and the ants effect this by constructing a wall. From below they carry up minute particles of debris which they build into a barrier at the ends of the tube. Near one edge of the barrier they leave a narrow slit, just wide enough to give them entrance into the tunnel, and, since a similar slit is made at both extremities, they are provided with two opposing gates. The resulting habitation is about an inch in length. It is shaped in the form of a flat triangle with a fissure-like cavity enclosed all round. Within, of course, is the accustomed herd reeding on the tissue of the leaf.

The folded structure of this leafy habitation reminds us of the architecture of the red ant. This latter species habitually nests in the foliage, drawing a number of leaves together and uniting their edges with a layer of silk. Sometimes, however, it employs a single leaf, bending it transversely so as to bring the apex to the base and then connecting the margins all round. This habitation of the *Cremastogaster* is, therefore, somewhat similar. A single leaf is taken and bent upon itself. It differs in that the fold is longitudinal instead of transverse, but more essentially in the fact that the *Cremastogaster* uses debris for the purpose of closing the ends of the tube. The red ant has no notion of such building operations. It is most expert at folding and approximating leaves and at weaving quantities of delicate silk, but it knows nothing of the art of accumulation of debris into the building of such material into a wall. When a gap exists in the nest of the red ant, the only method of securing the opening is by closing it with layers of silk.

But we must be careful not to overestimate the skill of the *Cremastogaster*. The tunnel, thus fashioned, is a complex piece of work, its edges being linked with threads of silk, its extremities closed with walls. It seems as if this ant combines two separate instincts, the erection of debris and the elaboration of silk. But this, I think, would be a false conclusion. It is greatly to be doubted if the occupying ants were responsible for the silken portion of this byre. I have never seen them employed in the manufacture of such material, though other kinds, of course, produce it in abundance, employing their larvæ for the generation of the threads. In this instance it seems more probable that a species of spider was responsible for the silken portion of the byre. The ants found the habitation partially constructed, its edges in apposition and connected with threads. They took the spider's industry to their own use, strengthened the chamber, added walls to its extremities, and thus by a combination of robbery and workmanship fashioned an excellent byre.

An idea can be gained of their mode of architecture when a breach is made in the wall of a byre. A few workers come out to attend to the damage and allocate to themselves the business of repair. They pull the little fragments back into place, piling them up and so adjusting them as to restore the broken part of

the wall. I see no special mechanism for holding them together, nothing analogous to the interlacing of threads such as other ants employ to bind the bricks. The architecture of the *Cremastogaster* is more primitive and simple. The bricks just naturally adhere to one another through the intertangling of loose shreds of tissue or the interlacing of plumed seeds.

On neighbouring trees we will find another type of byre-builder. This is a species of *Polyrhachis*, a larger, more powerful and more expert ant. It is partial to a different kind of vegetation, frequently choosing the orange and the peach. As an architect it is far more elaborate than the *Cremastogaster* since it spreads long tunnels over the trunks and branches, constructing them of debris interwoven with silk. The *Cremastogaster* can claim none of such remarkable efficiency; it superimposes and to some extent interlaces its fragments, working more like a bird at the building of its nest.

These works of construction are sufficient to indicate that the ants take great care of their valuable herds. Some workers remain continually with them, since those cattle, which have involved the ants in such labour, must on no account be left to themselves. Here is an example of their watchful care. I cut away a byre and thus expose the herd which had been enclosed probably for many weeks. But the workers in the vicinity soon came to the rescue and gave attention to their precious charge. Each took up an aphid in its jaws, some managed to get hold of two or three, and they quickly conveyed the exposed cattle to the shelter of the main nest.

Although these ants do not combine for the purpose of aggression, nor join their forces for the shifting of loads, nevertheless they possess that instinct of communication by which one ant can call out its comrades from the nest. In most ants the instinct is for the purpose of attack or in order to rescue a captured prey, but it has for the *Cremastogaster* the more peaceful use of bringing others to a discovered herd. Its manner of operation is according to principle, being conducted after the plan of the *Phidole* or the *Camponotus* which has been elsewhere described. Nevertheless there are certain details of interest which deserve a few brief notes. In order to see the operation I give a dead grasshopper to an ant. The wanderer is attracted to this rich morsel, immediately attaches itself, then bites at the integument, but soon, realizing the immensity of the discovery, runs down the branch in the direction of the nest. If it happens to meet a comrade the information is communicated. We observe the manner in which their antennæ meet. It is not just the usual passing touch such as occurs when the ants move ordinarily about. This is a more prolonged and agitated titillation, and has the effect of transferring to the second ant the enthusiasm possessed by the first. Then they separate and move in opposite directions, the discoverer descending to the main nest, the other ascending to where the treasure lies. We follow the discoverer down to the gate. Almost immediately on its entrance the workers issue forth. They do not emerge in any special formation. It is not a multitude like the legion of the *Phidole* nor a compact troop as in the *Camponotus* ants. The party of the *Cremastogaster* is a straggling line, each worker separately emerging from the gateway and independently ascending the branch. The discoverer does not lead them. On the contrary they are despatched and the ant that has brought the news may not emerge until many of the party have been sent on their course. Thus the instinct in *Cremastogaster* has reached considerable perfection in that the issuing column can reach the treasure without further help from the discovering ant.

The interrupted file ascends the tree, hastily, enthusiastically, in a long procession, and obviously aware of the good things in store. Reaching the grasshopper, each ant takes a grip of it; more and more follow and join in the combination until very soon the discovered insect is enveloped in a black mass of ants. The behaviour that follows is somewhat different from that of other species.

The *Phidole* army, for instance, falls violently on its victim, the troop of the *Camponotus* tears it limb from limb. Here, however, we observe a more quiet assemblage. The workers gather round it in great numbers. They bite at the integument, suck the exposed flesh, sometimes pile themselves thickly over it and encircle it in a dense ring. But there is no display of hostility or anger. Each worker merely tries to get a fragment for itself. This is in accordance with *Cremastogaster* habits. These ants are conspicuously individual in character; each one is in the habit of waiting separately on cattle and independently taking its share. Thus when they come forth to this rich discovery, they cannot, like other ants, combine to make use of it, but each pursues an individual course. It is for this reason that the issuing party is so straggling. The *Phidole* must advance in a multitudinous body in order to overwhelm and subdue the prey. The *Camponotus* for the same reason must join in a compact troop. But for this ant such immediate combination is unnecessary; hence the workers can emerge in a broken file.

As the *Cremastogaster* does not combine for the subjection of a victim, so also it cannot join to transport the mass. The *Phidole* or the *Camponotus* would have quickly moved it and transferred it bodily to the safety of the nest. But the *Cremastogaster* workers simply heap themselves about it. Each tries to break away a little fragment or to fill its belly with a droplet of the juice. But never do they make the slightest effort to shift it. They lack completely that instinct of combined transportation, and just feed on the carcass till it is an empty shell.

The reason is that under ordinary circumstances the *Cremastogaster* ant summons forth its comrades because it has happened to find a new herd. Their combination is peaceful, while in other ants it is aggressive. For their pastoral operations the art of capture is unnecessary, nor is the instinct of transportation required. It is easy to observe how they call assistance to the cattle. To a vigorous community I give a fresh herd. The ants had spent the season with aphids on the poplar, so I supply them with coccids on the leaf of a fig. The strange herd and foliage did not in the slightest disconcert them. The first worker that discovered them realized their value, but made no attempt to keep the treasure to itself. On the contrary it hurried down to the nest, distributed the news of the new fountain above, and very soon the snow-white heap of coccids was enveloped in a crowd of ants. Thus the workers in their discoveries show no greed for themselves. Their object is to tell of each fresh addition so that all may partake of the liquid store.

I have discussed in connection with other kinds of ants the mechanism by which this communication is performed. It has been shown that the discoverer, on returning to the nest, lays out behind itself a line of scent, and that the ants after emergence reach the treasure by following back along the scented track. There can be little doubt about their sense of smell. I place a nodule of camphor across their path. They are immediately disturbed by it and are reluctant to touch it. They come close up with the object of examining it, but quickly withdraw from the unpleasant odour and make a detour in order to get round. It is not that they are affected by the sight of the camphor, for other white objects are touched without hesitation when similarly placed so as to obstruct their line. Like other kinds of ants that move in files, they recognise their road by this faculty of smell. Anything that disturbs the scent confuses them and checks the ordered progress of their march.

But we are here considering the mechanism of communication, so I will mention an experiment connected with the act to show how precise is the olfactory sense. A long straight branch ascends from a nest and divides some distance higher up into three subsidiary stems. At the tip of one stem I give an insect to a worker. Very soon it establishes a line of comrades which moves first up the main branch, then out along the special stem. While this is in progress I do the

same on a second stem. The second ant hurries back with the news, and, on reaching the main ascending branch, runs direct into the file that the first ant called forth. It communicates with them, evidently tries to turn them, but the workers, though obviously excited by its touch, yet refuse to deviate from the correct path. They move out along the stem of the first experiment, that is the one to which they were primarily despatched. The second ant can gain no assistance from those despatched by the first ant ; it must complete the journey to the nest in order to send forth a party for itself. The fact is that the ants will not be confused when confronted with two diverging lines of scent. Certainly they show some little hesitation on reaching the point where the main branch divides. A few may move an inch or two in the wrong direction, many waver before choosing the correct stem. The diverging attractions obviously perplex them ; but this, we will notice, is little more than momentary, and all in the end take the right course. The ants will thus stick to the line of scent which the discoverer supplies them at the gate of the nest. Though other discoverers may meet them on the journey and though they may be agitated by this further information, nevertheless they keep to the primary impulse and maintain the line of the original scent. I repeat the operation on the third stem. In this way another discoverer is started, which on its descent to the main branch comes in contact with a pair of streams. Again I observe the same result. These streams will not be turned from their original directions. The third discoverer must descend all the way to the nest before it can collect its own party and despatch them to its individual find.

Thus, in this way, three streams pour forth from the nest. While on the main branch they all unite, and the ants ascend in a common flow. But where the stems diverge the stream breaks into tributaries, each tributary representing that particular portion despatched by the separate ants. How wonderfully efficient is the faculty of smell which results in such precision and accuracy of movement when confronted with diverging streams.

Another interesting point about the act of communication is that the instinct of the ants seems tempered with judgment in that the number of the workers called forth to the discovery is proportionate to the bulk of the find. Some of the first arrivals, after a preliminary investigation, make their way back again to the nest in order to summon still more to the scene. But they do not act imprudently, nor waste their numbers ; sufficient only for the purpose are despatched. An experiment will indicate this resourcefulness of operation, I cut a grasshopper into three unequal portions. The first is one-fifth of an inch in length ; the second is twice the bulk of the first, and the third twice the bulk of the second. I give these three pieces to separate workers on different parts of the same tree. Each discoverer, of course, brings back the news, and in a few minutes three streams of ants are ascending to the pieces of flesh. I give them plenty of time to continue the operation, not meddling with them for forty minutes, by which time the business must be absolutely complete. I then count the ants at the different pieces. Twenty-eight have been despatched to the smallest fragment, forty-four to the one of intermediate size, and eighty-nine to the largest piece. These numbers, it will be noticed, are roughly double of one another, which is the same proportion that exists between the bulk of the fragments supplied.

This same relationship may be observed to exist wherever the ants attend to their herds. A few aphids will have with them only two or three workers, while a large and vigorous cluster may attract twenty or more. One might imagine that all would crowd to the spot whenever a store of precious food was found. But they do not adopt such indiscriminate action ; they are possessed of a better and more frugal organization, and will not unnecessarily waste their strength. There seems to be some element of judgment in the act. If they sent forth the numbers for the purpose of capture or to carry off a burden, as in the case of the

Phidole, then it would be easier to understand the behaviour. It would merely be a case of the accumulation of reinforcements until sufficient had arrived either to quell the struggles or to cause the burden to move. The accomplishment of the purpose for which the ants were summoned would be the sign that sufficient had arrived. But these ants, as we have seen, do not combine for such an object. They all appear to act individually, each carrying off its own morsel to the nest. It would, therefore, seem that they are able to exert some little judgment, and to realize just how many are sufficient to deal with each source of supply.

In our observations of the habits of this *Cremastogaster* species we are sure to meet with a little beetle which forms an interesting association with the ants. It is not of the kind that visits the nest, but one that joins in the outdoor activities of the workers, especially in their domestic operations on the trees. It is most likely to be found on a bush of poplar, particularly one where crowds of ants are industriously tending their herds. If we are to find it we must search with considerable care, since it bears a very remarkable resemblance to one of the ordinary ants. It is in fact an excellent mimic, fashioned and clothed in such a manner that it can scarcely be distinguished in the midst of its friends.

This beetle is *Formicomus ninus* of Laferte and belongs to the family *Anthicidae*. (See plate).

Let us place it side by side with a worker ant and observe the resemblance between the two. In size and conformation they show very little difference. The beetle's head, though smaller than that of its model, resembles it in general shape. It has similar black spots to serve as eyes, and the antennæ are superficially like those of the ant. Behind it has the same kind of constricted neck, an ant-like thorax raised into an arch; a fair attempt has been made at the triangular abdomen by means of the pair of close fitting shards which are given that characteristic shape. But the most interesting feature is to be found in the coloration. The general scheme bears a perfect resemblance, the reddish brown of the head and thorax, with the glistening black of the triangular abdomen, being identical with that of the ant. The beetle, however, has something additional of which its model does not show a trace. There is on the back of its wing-covers, just behind the waist, two patches of white, one on either side. Each of these spots is oval in shape; it extends to the outer edge of the wing-cover but does not quite reach in to the middle line. Thus this part of the beetle presents the following appearance. On either side there is a light-coloured area, and between the two a line of black connecting the triangulated wing-covers with the chest.

An examination of the ant will explain the reason. It possesses a remarkably constricted waist, in fact the thorax is linked to the abdomen by little more than a mere thread. There is nothing of the kind in the conformation of the beetle, since it is the natural characteristic of this Order to have a broad, or at least, a moderately broad waist. Here, therefore, we observe a marked defect in the close resemblance between the beetle and the ant. In the one the waist is a broad hinge; in the other a slender thread. But the plan of colouration just described has for its object the restoration of this defect. Its purpose is to produce a false impression by giving the beetle the appearance of a waist. The two white patches on the sides of the wingcovers do not appear as if part of the beetle. They contrast so markedly with the surrounding black that their appearance is that of a deficiency in structure, as if a notch had been cut out of either side. The black line between them seems to be the true connection, and thus thorax and abdomen appear linked together by a slender artificial waist. Nature has thus wonderfully clothed the beetle, even to so minute a detail in its conformation, in order to make perfect its resemblance to the ant. Its bodily structure cannot be sufficiently altered, hence recourse has been had to a method of deception through the production of a false effect.

This little beetle, so remarkably adapted, wanders about on the stems and leaves. It lives in the open, seeking no concealment, and moves freely in the midst of the ants. Its accustomed haunts are identical with theirs, the cattle-laden foliage being the place of selection, though it also descends to explore the bark or investigate the debris underneath the tree. All its actions are peculiarly antlike. It has their rapid mode of ordinary progression, its legs working and antennæ trembling in their characteristic agitated way. Also, when engaged in searching the vegetation, it is in the habit of working round the edges of the leaves after the same methodical manner as the ants. Thus not only in structure, but in habits and behaviour there is a marked resemblance between the two.

The beetle seems to live a vegetarian existence, frequenting the poplar for the sake of its sap, as is also the purpose of the *Cremastogaster* ants. The beetle, however, receives the liquid direct, while the ants obtain it through the intermediation of the herd. In its wanderings we will frequently observe it to halt and commence to lick at the surface of the leaf. It may remain for a long time biting at the foliage as though able to get out the sap. These halts frequently take place near the base of a leaf, at which point there is a pair of minute papillæ that seem to attract the beetles to the spot. These are little glands which secrete a fluid that supplies the beetles with their most abundant food. The mimics and the ants live in perfect harmony. I never see a sign of hostility or friction. Though both compete for the precious fluid, yet they work together in rural peacefulness, the one existing on the products of the vegetation, the other, it may be said, domesticating a herd. The beetle is thus solely an outdoor visitor, a companion of the ants in their pastoral life.

We have here an excellent example of mimicry, since the beetle, as a consequence of its close resemblance, is lost to all but the most observant eye. There can be little doubt that the purpose of the mimicry is to supply the beetle with a garment of defence. These worker ants live a life of comparative immunity. Had they many enemies, they could not work with such freedom on the foliage, tending their herds in these conspicuous heaps. They are supplied with a sting and a reservoir of acid which must be sufficient to keep enemies off. But the little mimic, on the other hand, is altogether unprotected, having no weapons, nor poison, nor any knowledge of attack. Its search after sap must take it into the foliage where it will be fully exposed to view. Numerous dangers will there confront it, and, in all likelihood, it would cease to exist unless supplied with some suitable defence. It has, therefore, assumed the appearance of a worker, and, by living in the midst of the busy commune, is mistaken for one of the well-protected ants.

In this study of the habits of the *Cremastogaster* we have not met with anything of very striking originality, though we have observed a combination of organized methods different from that of any other kind of ant. The points of interest are the peaceful character of the workers and their peculiar love for certain types of vegetation because of the rich liquid food. Their pastoral activities take most of their attention, and they expend much labour in the erection of byres, though they have not arrived at the most perfect type. They are efficient enough in conveying information, in despatching their comrades to new supplies of provender, and are wonderfully skilful in following a path by means of their sense of smell. They are totally deficient in the capacity for transportation, at least beyond the carrying of an individual load. On the other hand they show some judgment in the distribution of their forces, despatching sufficient, and no more than sufficient, to deal with each source of supply. Lastly we have observed their companionship with a beetle which they effectually but unconsciously protect.
